INTRO

Chapter 1: Introduction

1.0 CHAPTER OVERVIEW

This chapter is an introduction to the *1998 Energy Efficiency Standards for Nonresidential Buildings, High-Rise Residential Buildings and Hotels/Motels*, as well as this *Nonresidential Manual.* The first section (1.1) summarizes the reasons for having energy standards. The second section (1.2) introduces the basic approaches to complying with the *Standards*, and briefly discusses some of the compliance options available. This is followed by two sections that outline the history of the *Standards* (1.3 and 1.4) since their inception in 1978, and the changes brought about by the 1998 *Standards*. The final section (1.5) explains the organization of this *Manual.*

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1.1 REASONS FOR ENERGY STANDARDS

There are numerous reasons to use energy more efficiently in buildings. One of the most obvious benefits is comfort. For example, on a hot summer day no reasonable amount of air conditioning will keep us cool sitting in a room surrounded by clear glass windows without any shading. The *Energy Efficiency Standards* (hereafter *Standards*) help ensure that new buildings maintain a high level of comfort.

A second reason for energy efficiency is economics. Investing in building energy conservation helps ensure that buildings are affordable to operate both now and into the future. Most efficiency measures in the *Standards* have a pay back period of less than five years and produce a positive cash flow. California's per capita energy consumption is declining slightly in part because of building and appliance efficiency standards. Cost-effective investment in energy efficiency also helps all citizens of California by keeping utility rates lower.

The *Standards* also produce environmental benefits. The need for more energy has led to oil spills, acid rain, smog and other forms of pollution. California is especially susceptible to these problems. In addition, the energy created by burning fossil fuels may lead to global climate change as a result of the "Greenhouse Effect." By the year 2009, existing building standards will save more energy than seven average power plants could produce.

The National Academy of Sciences recently urged the entire country to follow California's lead to "make conservation and efficiency the chief element in energy policy." The first efficiency recommendation was simple: "adopt nationwide energy efficient building codes."

1.1.1 Legal Requirements

All new buildings in California must meet the *Standards* and the administrative requirements of the *California Code of Regulations,* Title 24, Parts 1 and 6. Some requirements in the *Appliance Efficiency Regulations* of Title 20, Sections 1601 - 1608, also apply.

The statutory basis for the *Standards* is Section 25402 of the *Public Resources Code,* which states:

> *The California Energy Commission shall:" Prescribe, by regulation, ...building design and construction standards that increase the efficiency in the use of energy for new residential and new nonresidential buildings. The standards shall be cost effective, when taken in their entirety, and when amortized over the economic life of the structure when compared with historical practice. ...Six months after the commission certifies an energy conservation manual... no city, county, city and county, or state agency shall issue a permit for any building unless the building satisfies the standards prescribed by the commission ..."*

The purpose of this *Manual* is to explain clearly how to comply with and enforce the current *Standards* for nonresidential buildings. The *Manual* is written as both a reference source and an instructional guide, and can be used by architects, builders, building owners, designers, energy consultants, enforcement agency personnel, engineers, mechanical contractors and others directly or indirectly involved in the compliance process.

The *Manual* is divided into six chapters, each describing how the *Standards* apply to specific building components or situations.

1.1.2 Organization of the Standards

The 1998 Manual is organized to indicate how the *Standards* apply to the various building systems and situations. This organization is shown graphically in Figure 1-1.

1.1.3 California Climate Zones

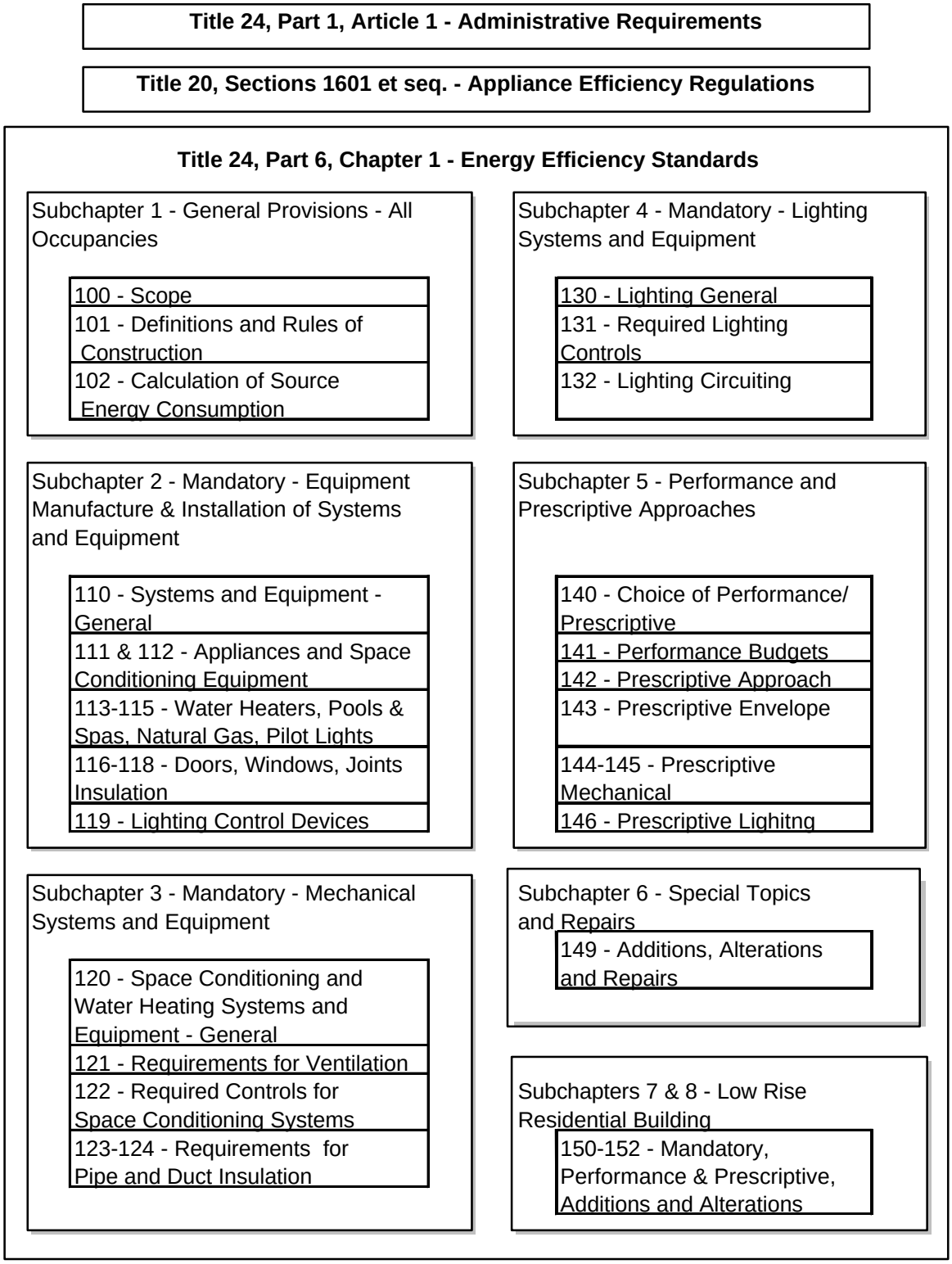
Since energy use depends partly upon weather conditions, which differ throughout the state, the Energy Commission has established 16 climate zones representing distinct climates within California (see Figure 1-2). These 16 climate zones are used with both the Residential and the Nonresidential *Standards*.

Detailed climate zone boundary descriptions and lists of locations within each zone are available in the Energy Commission publication California Climate Zone Descriptions for New Buildings, July 1995, (P400-95-041).

NOTE: cities may occasionally straddle two climate zones. In these instances, the exact building location and correct climate zone should be verified before any calculations are performed.

If a single building is split by a climate zone boundary line, it must be designed to the requirements of the climate zone in which 50 percent or more of the building is contained.

Figure 1-1: Organization of the Nonresidential Standards



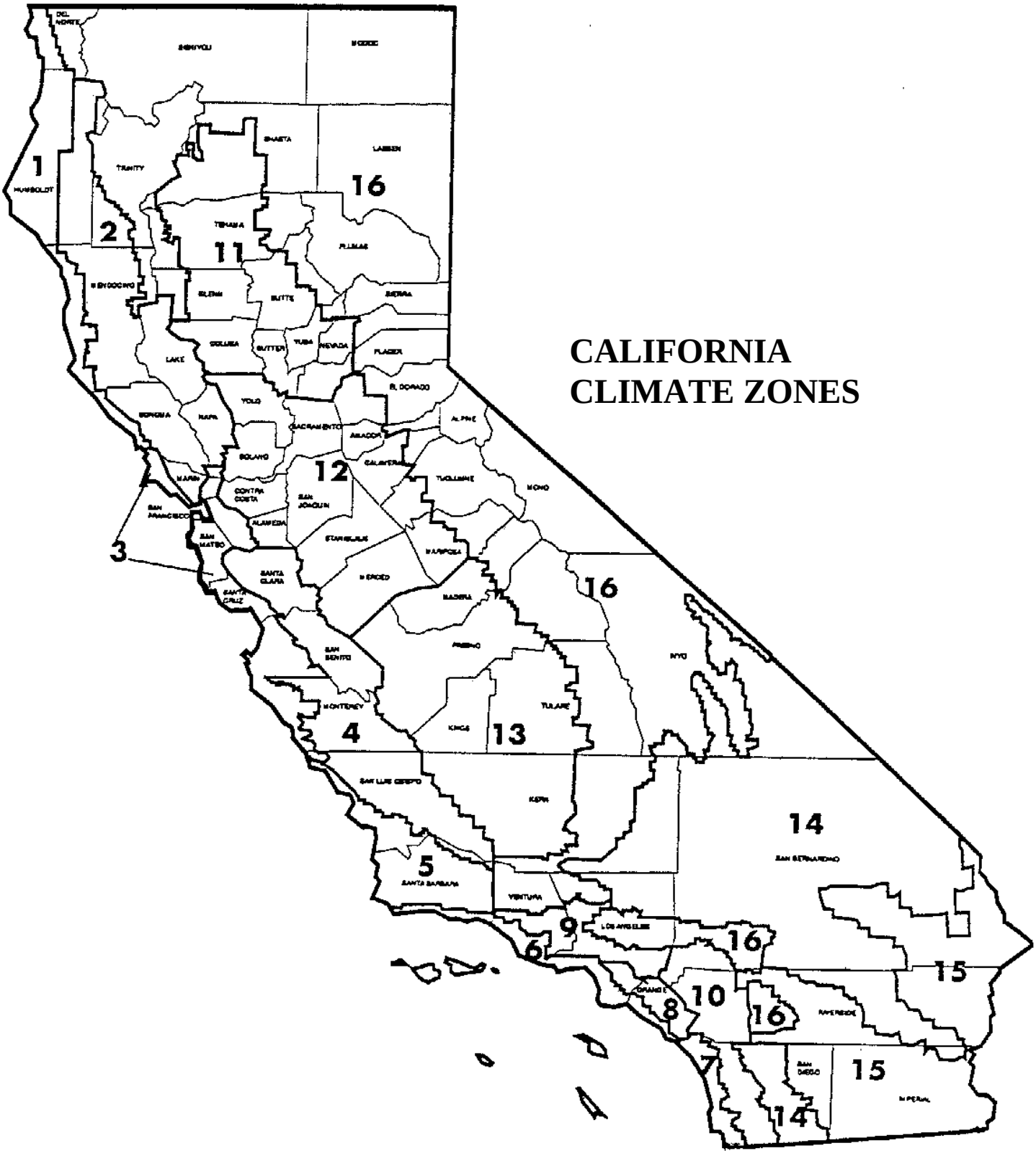
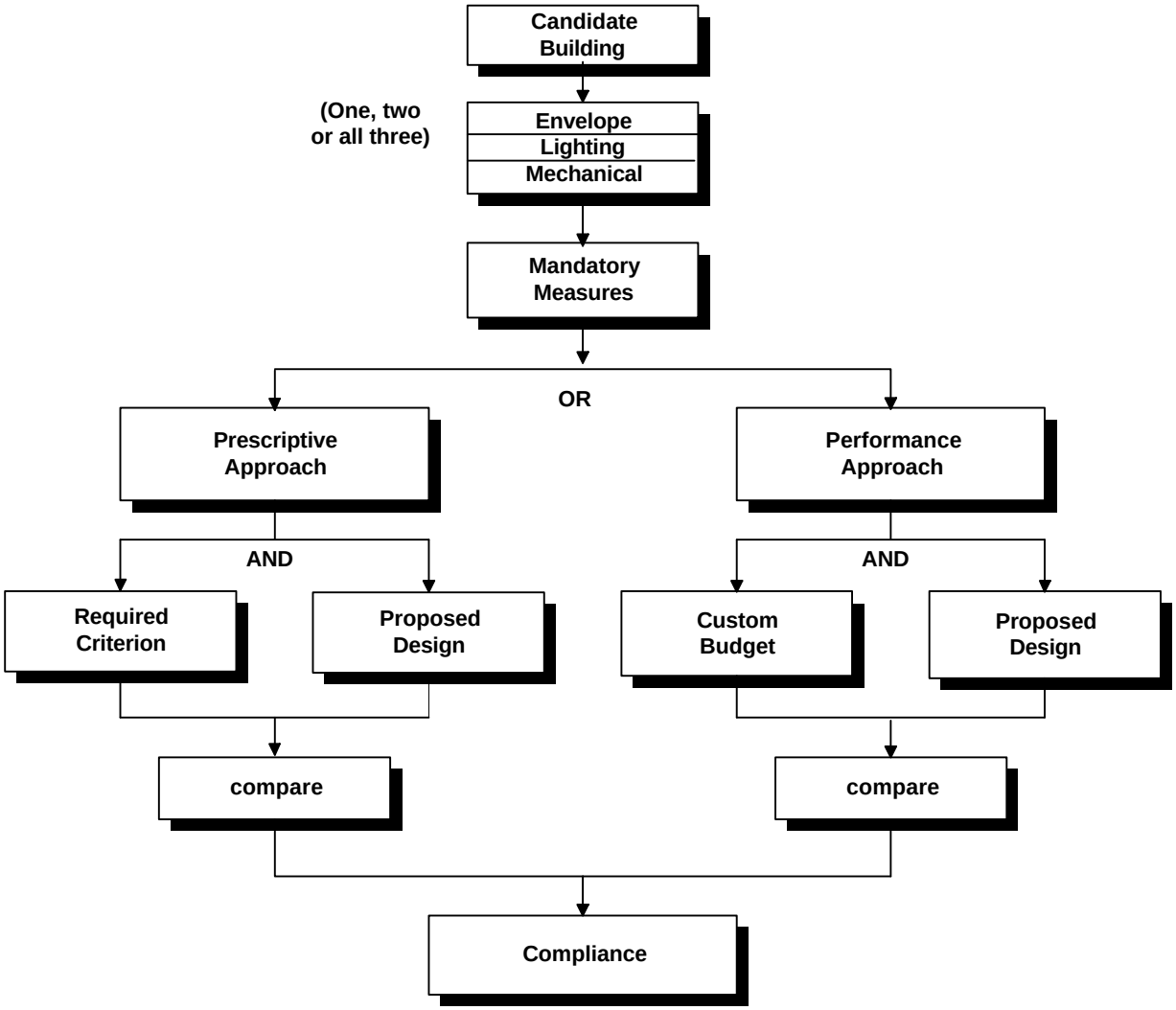


Figure 1-2: California Climate Zones

Figure 1-3: Nonresidential Standards Flowchart



1.2 BASIC APPROACHES TO COMPLIANCE

The *Standards* provide flexibility to the designer in choosing an approach to comply with the requirements. This section gives an introduction to the basic choices, or approaches, that are available. The details of how the different approaches apply to the building and its systems are covered in the following chapters.

There are two basic options for demonstrating that a building meets the requirements of the *Standards:* the prescriptive approach and the performance approach.

With either approach, certain mandatory measures always apply.

The *Standards* cover the three major components of a nonresidential building: the building envelope, the mechanical systems, and the lighting systems. A minor energy user, water heating, is also covered. Each component is typically the responsibility of a different design professional. The envelope is designed by an architect, the mechanical systems by a mechanical engineer, and the lighting systems by an electrical engineer. Each of the three com-

ponents may be shown to comply independently under the prescriptive approach. Under the performance approach, *Standards* compliance may be shown for the envelope only, the envelope and mechanical systems, or for all three components.

Alternatively, the building (all three components) may be shown to comply as a whole under the performance approach when the permit application includes all three components.

Figure 1-3 graphically illustrates how the three nonresidential building components must each comply with their mandatory measures, and then either the prescriptive or performance approaches.

The mandatory measures for each of the three components are described in Chapters 3, 4, and 5.

The prescriptive approach is the simpler way to comply with the *Standards*. Each of the three building components complies separately from the others. The compliance procedures and documentation are also separate for the three.

The prescriptive approach for each component requires that the proposed system design be shown to meet specific energy efficiency criteria specified by the *Standards*. If the design fails to meet even one of the requirements, then the component does not comply with the *Standards*.

Prescriptive Envelope: The prescriptive envlope requirements are determined either by the Envelope Component Approach or the Overall Envelope Approach. These two approaches are described in detail in Chapter 3, beginning with an introduction in Section 3.2. The stringency of the envelope requirements varies according to climate zone and occupancy type.

Prescriptive Mechanical: The prescriptive mechanical requirements are described in detail in Chapter 4. The prescriptive *Standards* do not offer any alternative approaches, but specify hardware features and design procedures that must be followed.

Prescriptive Lighting: The prescriptive lighting requirements are determined by one of three methods: the Complete Building Method, the Area Category Method, or the Tailored Method. These three approaches are described in detail in Chapter 5, beginning with an introduction in Section 5.2.1. The allowed lighting under the *Standards* varies according to the requirements of the particular building occupancy or task requirements.

Performance Approach: The performance approach allows a wider variety of design strategies and provides greater flexibility than the prescriptive approach. It is based on an energy simulation model of the building. The *Standards* specify the method for determining an energy budget for the building. This is known as the *custom energy budget,* because it is generated on a case-by-case basis. This energy budget is the goal for energy efficiency that the building must meet.

Four basic steps are involved:

- Design the building with energy efficiency measures sufficient to meet the energy budget. (The prescriptive approach requirements provide a good starting point for the development of the design.)
- Demonstrate that the building complies with the mandatory measures (see Chapters 3, 4 and 5).
- Model the energy consumption of the building using an approved calculation method. This results in the energy budget.
- Model the energy consumption of the building using the proposed features. If the consumption is no greater than the energy budget, the building complies.

The designer is permitted to trade off different aspects of the building design, one against the other, when applications for more than one components permit are requested at the same time. If the final design does not exceed the energy budget, the design element is included in the building permit application.

1.3 HISTORY OF THE STANDARDS

The Organization of Petroleum Exporting Countries (OPEC) oil embargo of 1973 brought about an acute awareness of the need for an effective state energy policy. The Legislature created the State Energy Resources Conservation and Development Commission (Energy Commission) in 1974 to deal with energy-related issues, and mandated that the Energy Commission adopt conservation standards for new buildings. The Energy Commission first adopted such standards in 1977.

So-called “First Generation” standards for nonresidential buildings took effect in 1978. Those nonresidential standards remained in effect for all nonresidential occupancies until January 1987, when “Second Generation” standards took effect for office occupancies. Second Generation standards for retail and wholesale occupancies took effect in July 1988. Also in July 1988, all nonresidential lighting compliance was under the Second Generation standards, while envelope and space conditioning compliance requirements for nonresidential occupancies (except office and retail/wholesale buildings) remained the same ("First Generation") from 1978 until the *1992 Nonresidential Standards* took effect. Optionally, from July 1988 until July 1992, permit applicants could show compliance for First Generation occupancies using a Second Generation compliance method.

High-rise residential and hotel/motel occupancies were covered under the *1978 Residential Standards* until July 1992, when they were placed within the structure of *1992 Nonresidential Standards*. The first generation standards applied only to the building envelope. Lighting and mechanical systems (except electric resistance heating) in both high-rise resdential and hotel/motel buildings were not regulated until July 1, 1992.

The *1992 Nonresidential Standards* consisted of a major restructuring of the format of the *Standards.* The 1995 and 1998 *Energy Efficiency Standards* focus on compliance and implementation issues rather than developing new standards. Lighting allowances were updated for the first time in 10 years.

This section highlights the major changes included in the *1995 and 1998 Standards* for nonresidential buildings.

Table 1-1 summarizes the *History of the Standards and Manuals* in effect since 1978 and lists the name of the compliance manual that was used in conjunction with that set of *Standards*.

Table 1-1: History of Standards and Manuals

Date	Set of Standards	Compliance Manual
1978	First Generation Residential (including Hotels and High-rise)	Energy Conservation Design Manual for New Residential Buildings (2/78)
1978	First Generation Nonresidential	Energy Conservation Manual for New Nonresidential Buildings (10/77)
1983 to 1984	Second Generation Residential (excluding Hotels and High-rise)	Energy Conservation Manual for New Residential Buildings (Fall, 1984)
1987	Second Generation Nonresidential (only Office)	Energy Efficiency Manual, Designing for Compliance (12/86)
1988	Second Generation Nonresidential (Office and Retail/Wholesale)	Energy Efficiency Manual, Designing for Compliance (12/86)
1988	Second Generation Residential (excluding Hotels and High-rise)	Energy Conservation Manual for New Residential Buildings (7/88)
1992	Nonresidential Standards (includes Hotels and High-rise Residential)	Nonresidential Manual for Compliance with Energy Efficiency Standards (7/92)
1992	Residential Standards (excludes Hotels and High-rise)	Residential Manual for Compliance with Energy Efficiency Standards (7/92)
1995	Nonresidential Standards (includes Hotels and High-rise Residential)	Nonresidential Manual for Compliance with Energy Efficiency Standards (7/95)
1995	Residential Standards (excludes Hotels and High-rise)	Residential Manual for Compliance with Energy Efficiency Standards (7/95)
1998	Nonresidential Standards (includes Hotels and High-rise Residential)	Nonresidential Manual for Compliance with Energy Efficiency Standards (7/98)
1998	Residential Standards (excludes Hotels and High-rise)	Residential Manual for Compliance with Energy Efficiency Standards (7/98)

1.4 CHANGES IN THE STANDARDS

1.4.1 Structural

Beginning with the 1992 *Standards, there is* no longer a grandfather clause that allowed compliance for a building that began with a certain standard, to continue under that standard until the building was completely constructed. Also there was no reference to past standards on a permit application. These *Standards* apply to all nonresidential as well as to all high-rise residential, hotels, and motels since these occupancies more closely resemble nonresidential than residential in terms of their mechanical systems and energy use patterns.

The *Standards* apply only to the systems and portion of the building for which a building permit is sought. This simplifies both compliance and enforcement, virtually eliminating the need to consider other systems or parts of the building in the compliance process.

The prescriptive *Standards* do not permit energy efficiency trade-offs between systems. Each of the three sections, envelope, mechanical and lighting, stand alone.

The performance approach establishes the energy budget on a custom basis for each building. The custom budget is automatically generated by an approved computer program that is used to estimate the building's annual energy use.

The performance approach limits the range of options available for trade-off (items that can change between standard and proposed cases). Trade-offs are only allowed for those features specifically included in the building permit application, as well as for all existing conditions and systems that are to remain and are subject to the current *Standards* (see Section 6.1). Systems that will be installed under a future permit application are not available for trade-off. NOTE: the building department may require special documentation to substantiate *as built* conditions.

1.4.2 Technical

The *1998 Energy Efficiency Standards* become effective July 1, 1999.

A. SCOPE and APPLICATION:

- A new category of "semi-conditioned" building will comply with lighting requirements. A semi-conditioned building is a nonresidential building with conditioning that currently does not meet the definition of a directly conditioned—less than 5 Btu/hr/ft² of cooling, less than 10 Btu/hr/ft² of heating, evaporative cooling, wood heat, conditioned for a process environment below 55 or above 90° F.

- The definition of directly conditioned is changed to exclude from compliance spaces that are not *maintained* outside the comfort range (55 - 90°F), that is the temperature floats in and out of the comfort range, but are incapable of *operating and maintaining* the space within the comfort range.

- Definitions of mechanical cooling and mechanical heating remove the phrase "for the purpose of maintaining human comfort."

B. ENVELOPE:

- The heat gain and heat loss equations were updated for accuracy and the heat gain equation now considers the effects of opaque surfaces where it formerly considered only fenestration.

- Prescriptive high-rise residential requirements now include insulation for concrete raised floors (e.g., apartments with underground parking) to match low-rise requirements. R-4 is required in climate zones 12 and 15, and R-8 in climate zones 1, 2, 11, 13, 14 and 16.

- When a portion of an entire building's fenestration is repaired or replaced, or 50 square feet or less of glass is added, compliance with the solar heat gain coefficient requirements of Section 143 is not required.

- All manufactured fenestration products must have a label with the U-value and Solar Heat Gain Coefficient (SHGC). These values can be NFRC or default values. The default values are found in the *Standards*, Section 116.

- Glazed wall systems and overhead glazing do not need to be labeled. These products must still determine a U-value and SHGC using NFRC or default values.

- Field-fabricated fenestration does not need to be labeled. These products will use the default values. This term replaces site-built, and applies to products whose frame is made at the construction site of standard dimensional lumber or other materials that were not previously cut, or otherwise formed with the specific intention of being used to fabricate a fenestration product or exterior door. Field fabricated does not include site assembled frame components that were manufactured elsewhere with the intention of being assembled on site (such as knocked down products, sunspace kits and curtainwalls).

C. MECHANICAL:

- All pressure-sensitive tapes, mastics, aerosol sealants or other duct closure systems must meet applicable UL 181 requirements

- Drawbands Used with Flexible Duct shall:

  (a) be either stainless-steel worm-drive hose clamps or uv-resistant nylon duct ties.
  (b) have a minimum tensile strength rating of 150 pounds.
  (c) be tightened as recommended by the manufacturer with an adjustable tensioning tool.

- Prescriptive fan power limitations for variable air volume systems are changed to reflect improvements in technology and system efficiency. Individual VAV fans with motors over 25 HP (adjusted for air filtering systems) must meet one of the following:

  (a) The fan motor shall be driven by a mechanical or electrical variable speed drive.
  (b) The fan shall be a vane-axial fan with variable pitch blades.
  (c) The fan motor shall include controls that limit the fan motor demand to no more than 30% of the total design wattage at 50% of design air volume when static pressure set point equals 1/3 of the total design static pressure, based on certified manufacturer's test data.

- A new exception to prescriptive economizer requirements is provided for spaces or rooms with a dedicated space conditioning system where the use of outdoor air is detrimental to equipment or materials. Possible examples include computer room, telecommunications, and other equipment rooms.

D. LIGHTING:

- Reduced control credits for lumen maintenance (from 10 to 5%) and for combined occupancy sensor and lumen maintenance (from 37 to 25%).

- 22 new categories of building uses are added to the Area Category Method.

- Lighting levels in all compliance approaches are reduced to account for substituting T-8 lamps with electronic ballasts for T-12 lamps with magnetic ballasts. Reductions are based on the prevalence of fluorescent lighting in the building model.

1.5 ORGANIZATION OF THIS MANUAL

This *Nonresidential Manual* is organized into six chapters plus several appendices. Each chapter of the *Manual* covers a major set of related topics regarding compliance with the requirements of the *Standards*.

Chapter 1, this *Introduction,* serves as a brief overview of the *Standards* and this *Manual.*

Chapter 2 discusses the *Scope and Application* of the *Standards*, explaining when they apply to a particular building and discussing some application problems that may arise. Chapter 2 will help in deciding if the *Standards* apply to the project.

Chapters 3, 4 and 5 discuss the *Standards* in terms of the three major components: envelope, mechanical and lighting. These chapters are written to be largely stand-alone for the discipline to which it applies. For example, the HVAC system designer will find all the mechanical system requirements fully discussed in Chapter 4. Likewise, the building department's mechanical plan checker and inspector can concentrate on Chapter 4.

These three chapters are organized into subsections that address the major phases of a building project:

- The *Design* section discusses the requirements as they affect the design process; the principles of each requirement are explained and illustrated.
- The *Plan Check Documents* section is addressed to those who prepare the construction documents and compliance calculations for review by the building department's plan checker. It is also addressed to the plan checker. This section focuses on the specific information that must be included in the plans and on the compliance forms to adequately demonstrate compliance.

Each of the sections addresses the Mandatory Measures, the Prescriptive Approach and the Performance Approach.

The organization of these three chapters is illustrated in Figure 1-4.

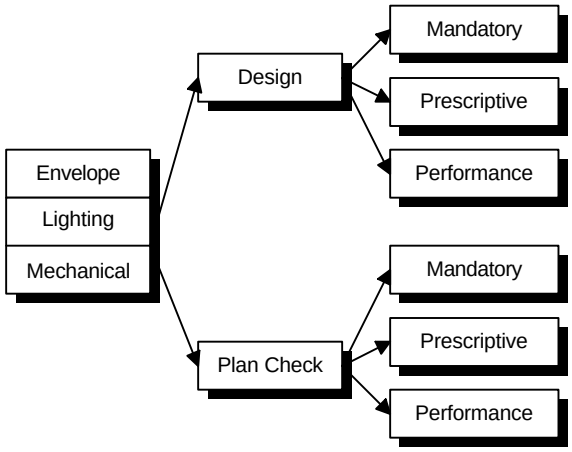


Figure 1-4: Organization of Chapters 3, 4 and 5

In addition to the major parts of these three chapters, there are two sections at the beginning of each chapter.

Chapter Overview - provides a brief overview of the chapter contents.

Introduction - provides basic information about the component and its compliance requirements:

> *Compliance Approaches* - explains the options available for compliance for the given building component.
>
> *Basic Concepts* - explains the definitions and technical concepts necessary to an understanding of the *Standards* requirements applicable to the component.

Chapter 6 - discusses several *Special Topics* that can apply to any of the components. This includes a discussion of the Performance Approach, High-rise Residential Buildings, and Hotels and Motels.

Appendices - contain reference tables, charts and definitions that support the implementation of the *Standards,* including data on construction assemblies, and Climate Zone Descriptions.

Tables of Contents and Index - at the front and back of the Manual - provide two types of cross-references to the material in the document.

Note: Two notation conventions are used throughout this *Manual* in making cross-references:

1. References to other locations within this *Manual* are called out by Section number:

   "see Section 3.2.2D"

2. Some references to the *1998 Energy Efficiency Standards* are called out by section "§" number: "§143(b)"

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